Using Big Data to Optimise Tertiary Education Facility Operations

TEMC 2015

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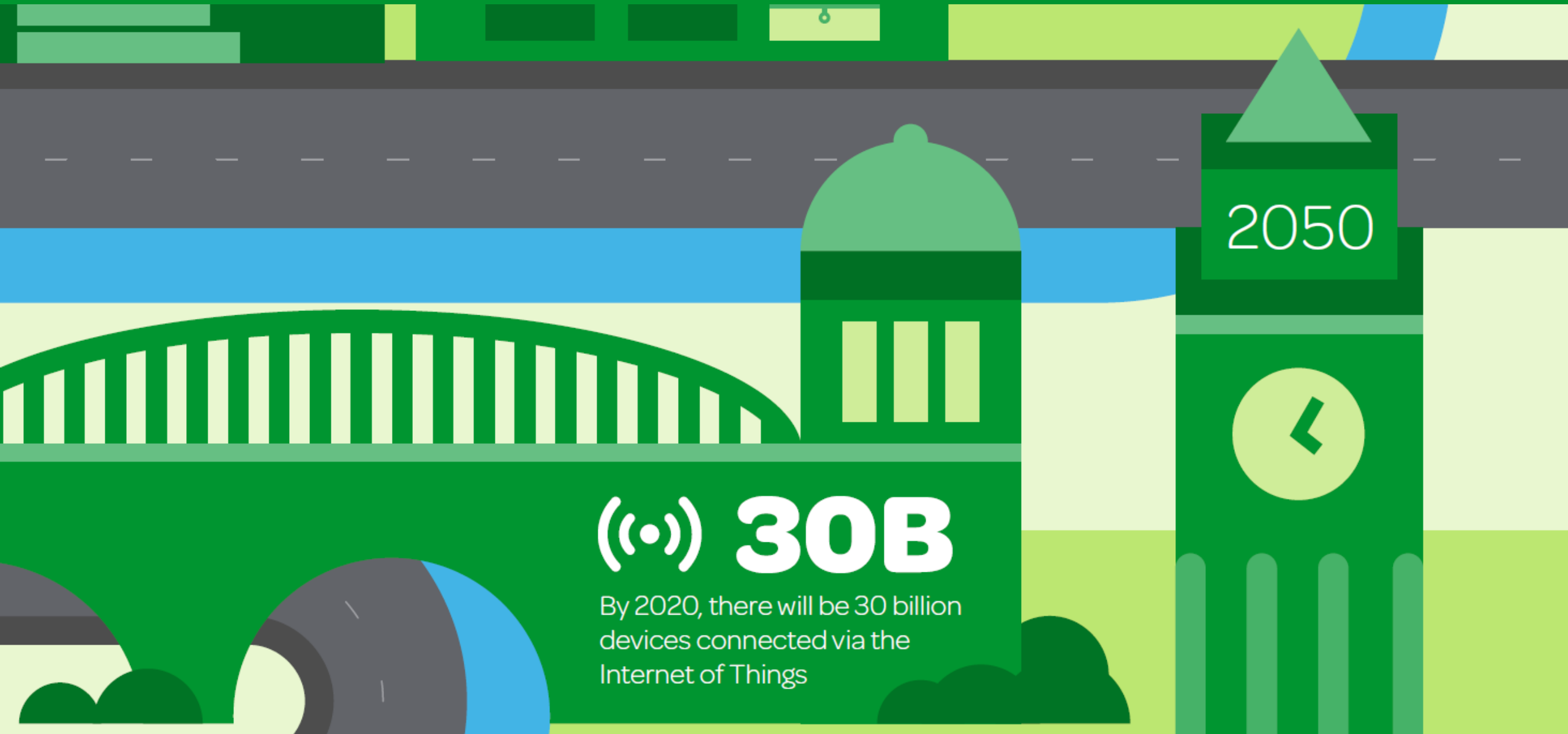
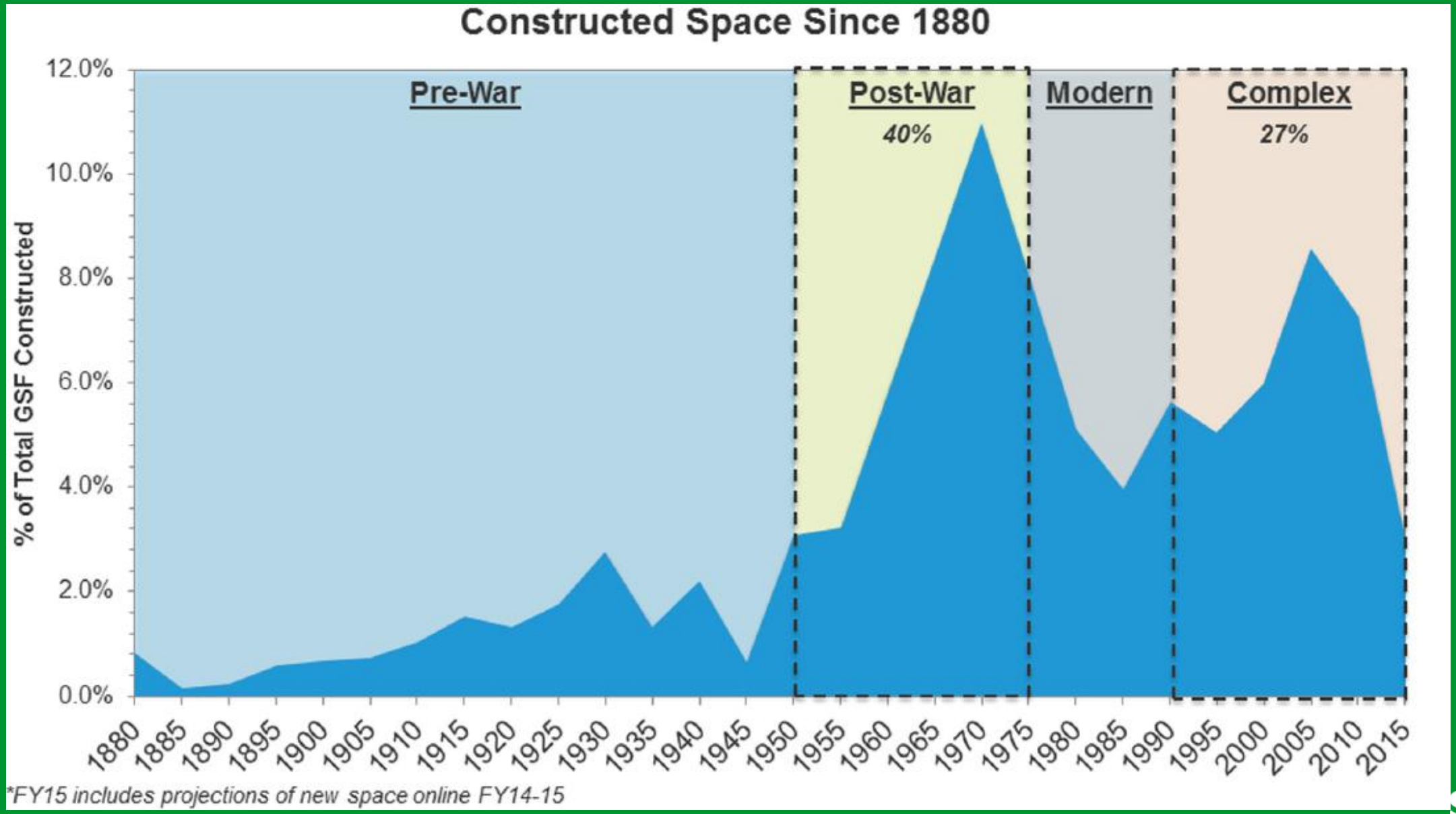
Schneider Electric

IoT Provides Opportunities in Buildings



Changing Education Methods and Impact

Campus Space



State of Facilities in Higher Education 2014 Best Practices, Benchmarks and Trends, Sightlines

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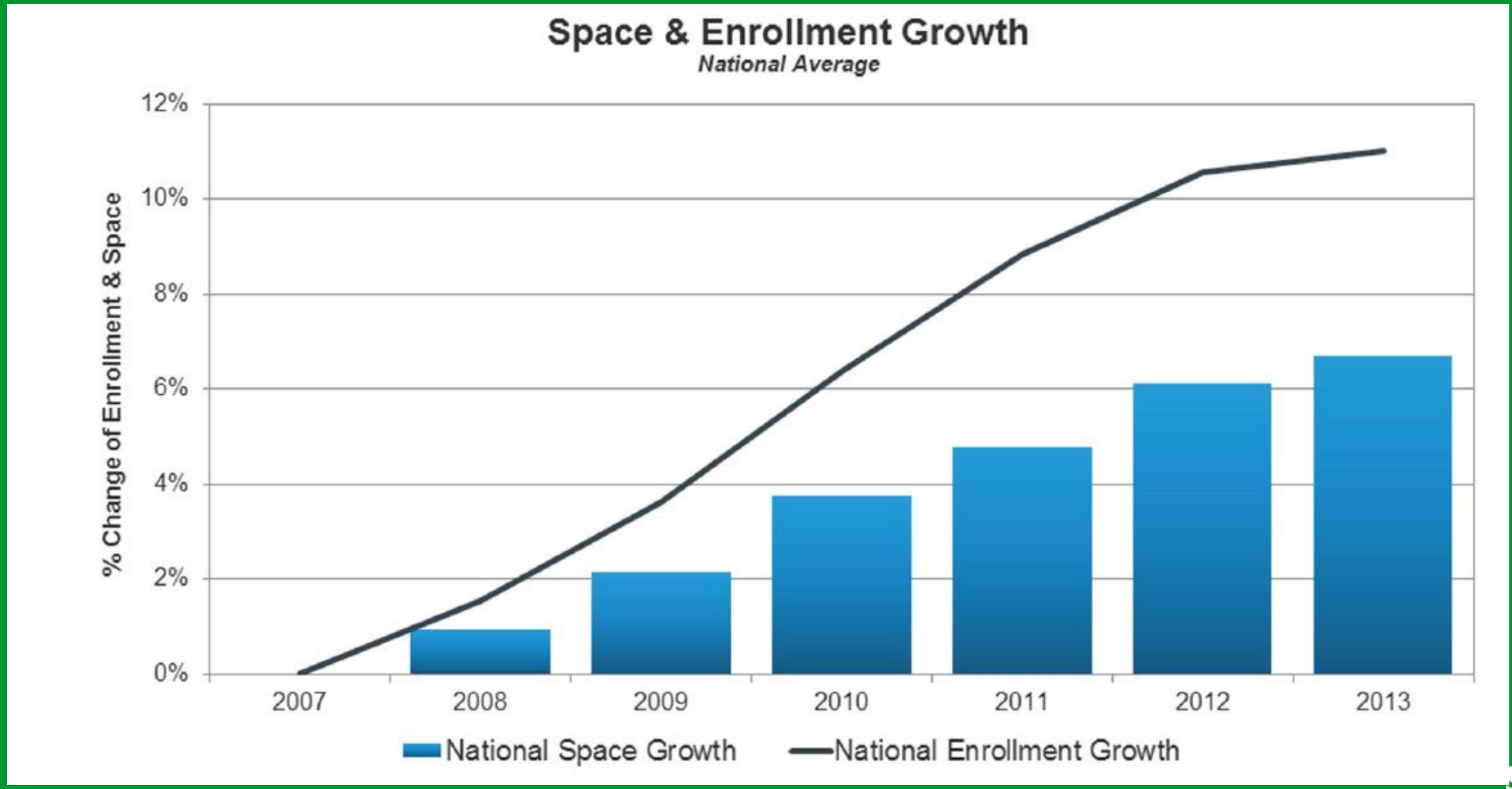
Campus Density



State of Facilities in Higher Education 2014 Best Practices, Benchmarks and Trends, Sightlines

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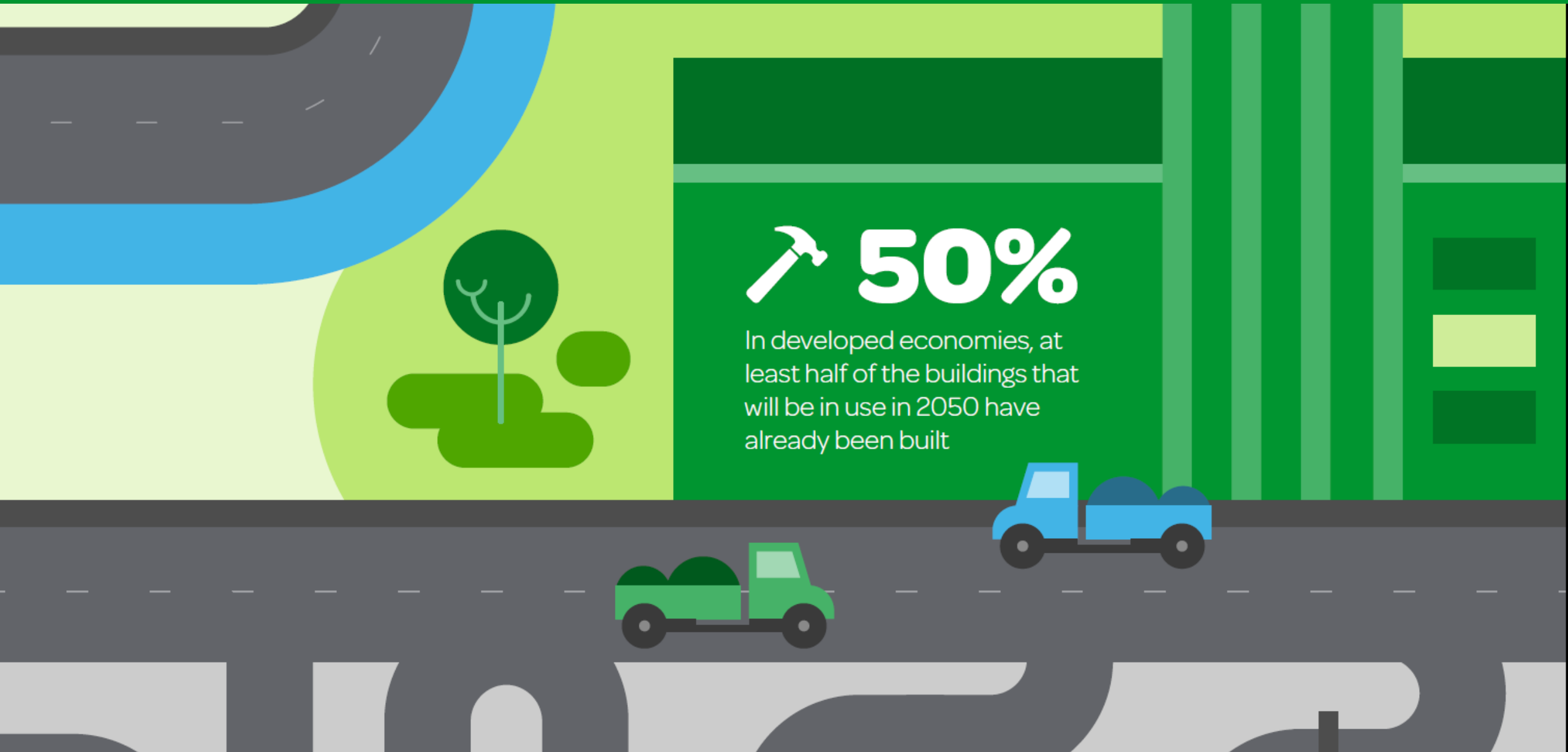
Critical Drivers are Impacting All Industries

- Aging stock
- Labour
- Outsourcing
- Risk
- Emerging technology
- Sustainability

Buildings are a Huge Energy Drain



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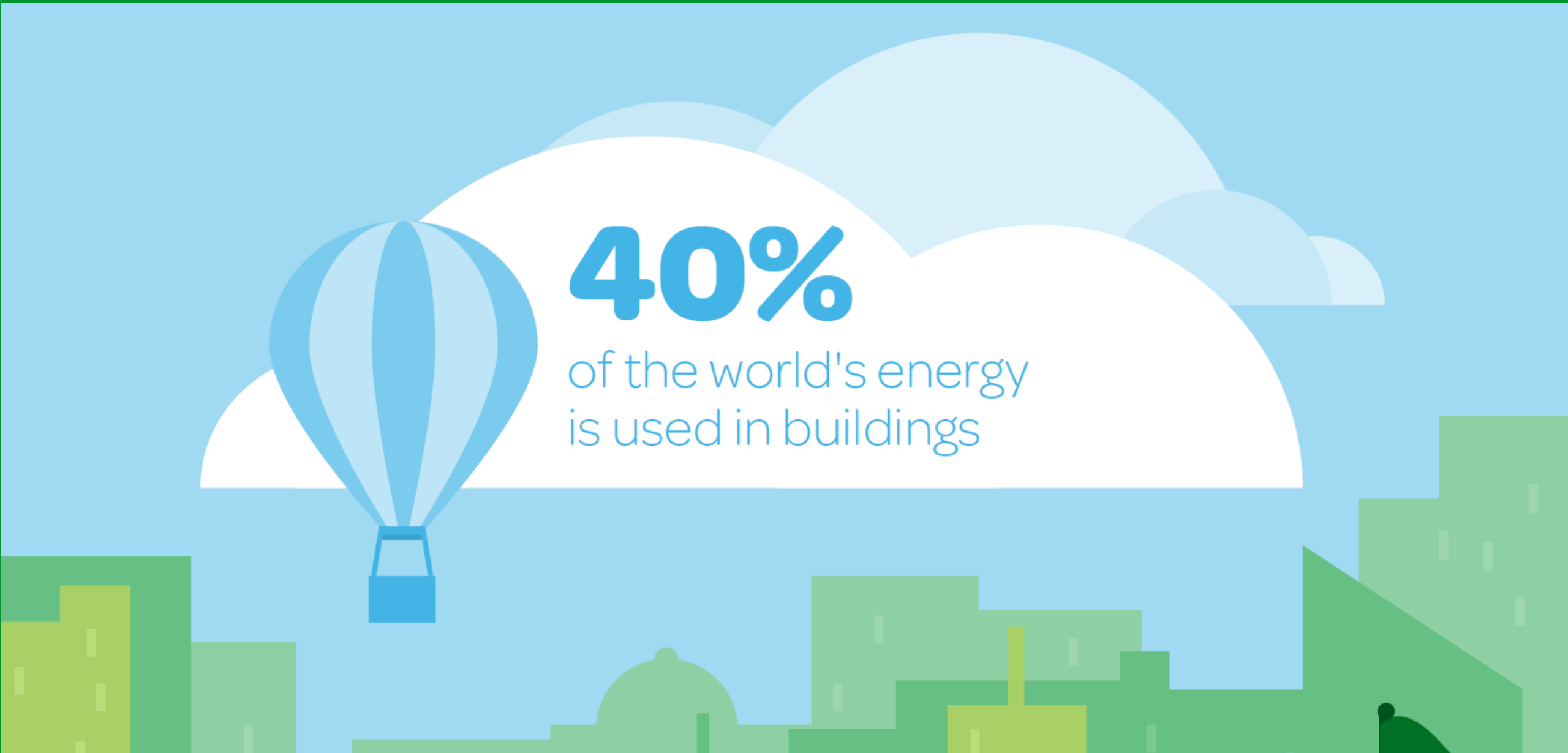


Lifecycle Costs

$ 75%

75 percent of a building's cost over its lifetime will go toward maintenance and operating expenses

20%

Only 20% of facility managers use 80% of the available capabilities in their building management systems

BMS and Dashboards

BMS:

> Review graphics

> View Alarms

> Set up Trends

Energy Dashboards:

> Metrics

> Manually spot trends

> Indicate where inefficiencies may be

aFDD

Automated Fault Detection and Diagnostics:

> Hierarchical
> Rule-based
> Rules are inter-related
> Identify likely root causes
> Prioritises faults based on their impact
> Monetises wastage

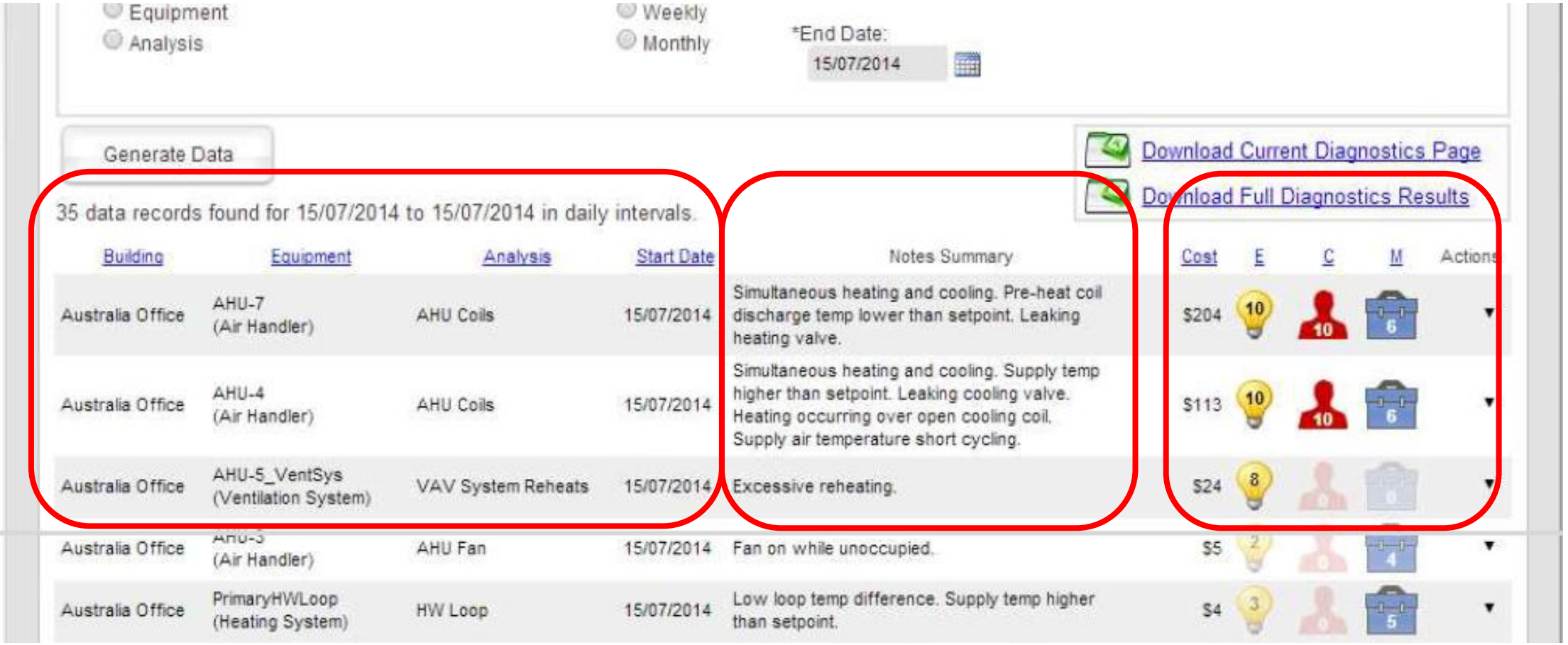
AFFD Examples

Common Plant Type	Typical Items Checked
AHU Coils	AHU Coils --Preheating, cooling, heating, dual temp, and heat recovery coils --Supply air temp, humidity, dewpoint setpoint tracking --Return air temp, humidity, dewpoint setpoint tracking --Supply/Return reset schedule --Coil discharge temp tracking --Coil leaking or stuck coil --Coil short cycling --Simultaneous coil operation or demand --Simultaneous heating and cooling --Compressor issues --Gas valve issues
AHU Economiser	AHU Economizer --Broken flow sensor --Damper short cycling --Minimum outdoor air damper/flow issues --Imbalanced air flows --Return air CO2 tracking --Mixed air temp sensor issues --Mixed air temp setpoint tracking --Inefficient economizing --Excess mechanical cooling --Economizing + heating --Fresh air fraction --Stuck damper
AHU Exhaust	AHU Exhaust Fan --Exhaust fan running when AHU off --Exhaust static pressure sensor drift --No air flow when exhaust fan on --Exhaust air flow tracking --Exhaust static pressure tracking --Exhaust air temp tracking --Exhaust fan short cycling --Abnormal exhaust fan current --Exhaust fan and occupancy --Exhaust vfd fan speed constant
AHU Fan	AHU Supply/Return Fan --Fan speed feedback issues --Fan running when AHU off --Fan static pressure sensor drift --No air flow when fan on --Air flow setpoint tracking --Air static pressure tracking and reset --Fan short cycling --Abnormal fan current --Fans and occupancy --VFD fan speed is constant

AFFD Examples

Common Plant Type	Typical Items Checked
Chiller Efficiency	Chiller Efficiency --Chiller performance (efficiency, NPLV, heat balance, COP) --Low efficiency --Bad heat balance
CHW Loop	CHW Primary Loop --Setpoint is zero --Supply/return temp setpoint and reset tracking --Underloaded loop --Loop differential pressure setpoint and reset tracking --High/low differential pressure setpoint --No flow, pumps on --Water flow setpoint tracking --System on with no demand --VFD installation
Cooling Plant	Cooling Plant Operations --Chiller status vs run command --Too many/not enough pumps running --Uncoordinated free cooling isolation valves --Uncoordinated chiller isolation valves --CW fan and pump simultaneous operation --Pumps on while cooling off

Software Example



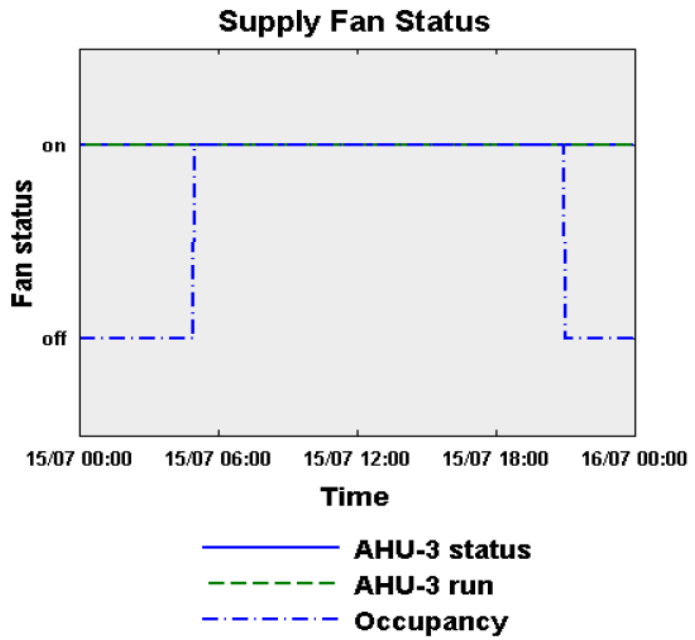
Analytics Examples

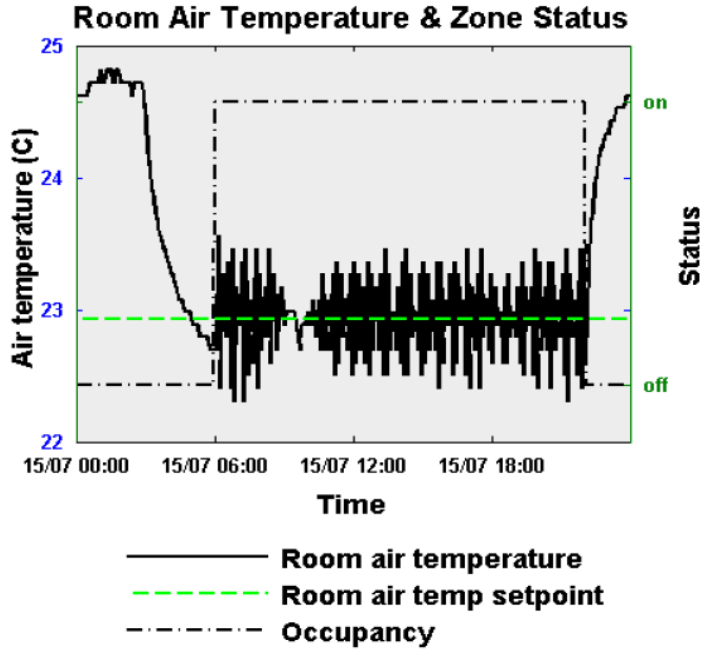
> Collects, stores and trends building data

> Automatically detects anomalies

> Prioritises:

- Energy waste
- Comfort issues
- Operational inefficiencies





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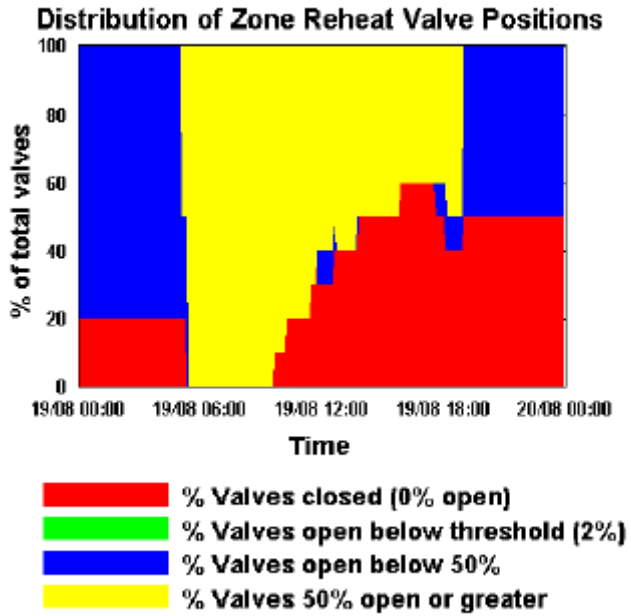
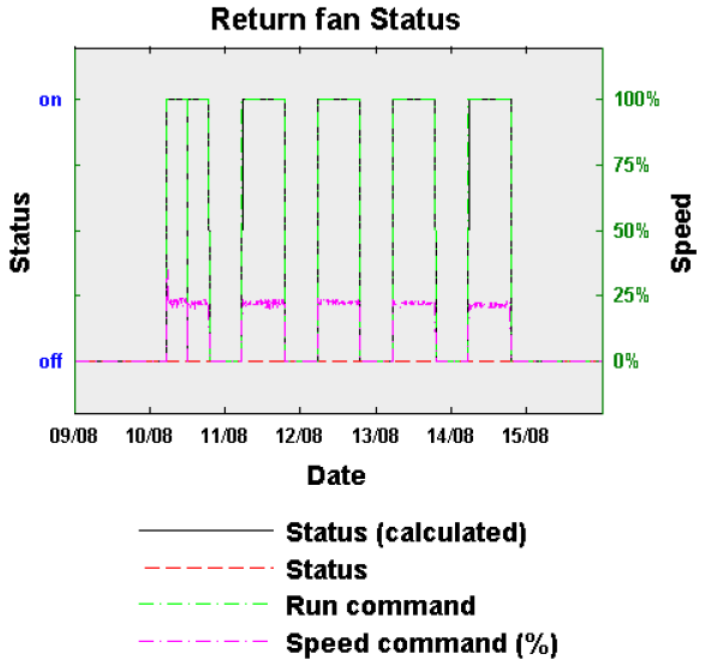
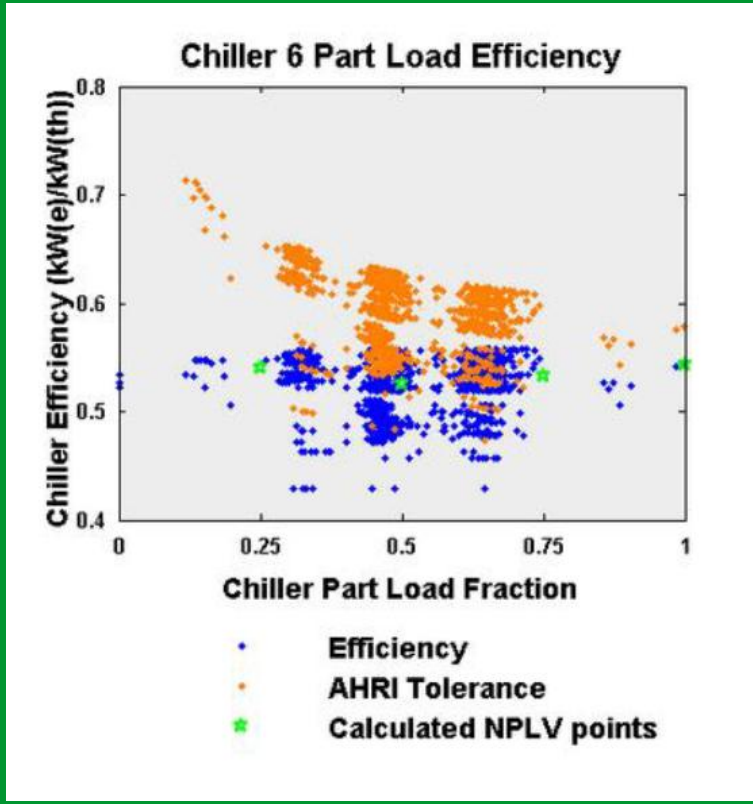
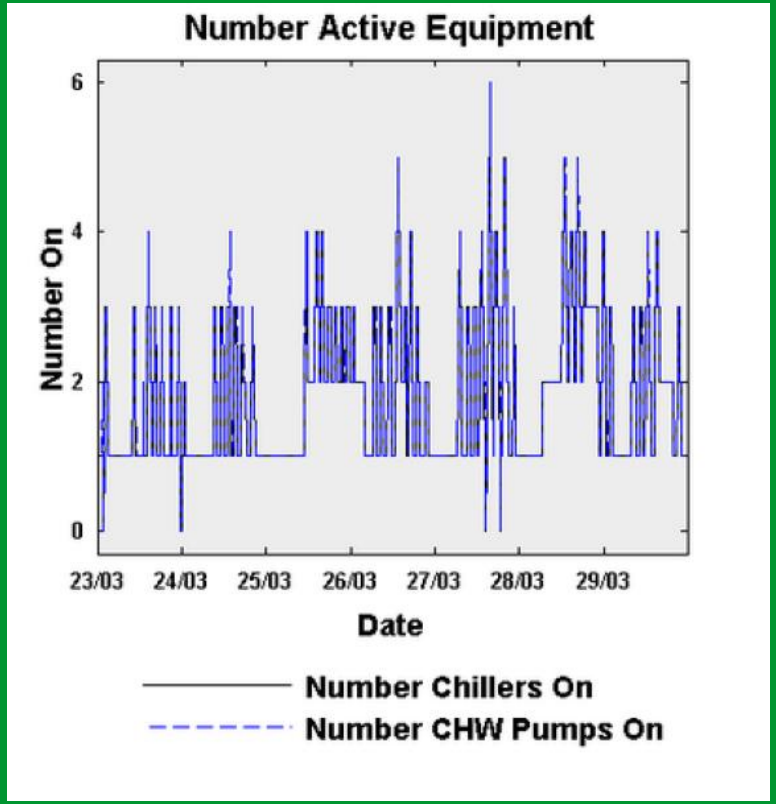
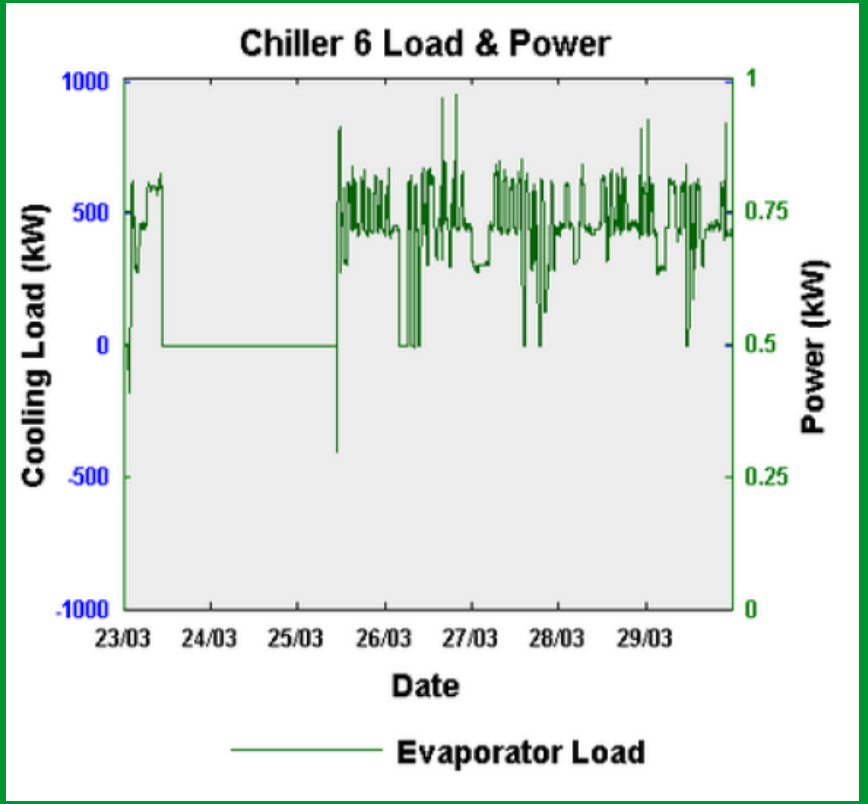




Analytics Examples - Chiller Efficiency







Deployment Options

Analytics Solution	Pros	Cons
Embedded Analytics	•Installed from day 1	•Not sufficiently developed today •Not cost effective today
Custom Built System	•Flexible •Tailored	•High Cost •Staff to deploy and operate •IT and cyber security responsibility •Difficult to deploy across multiple sites
SaaS	•Automated •Web based •Lowest deployment cost •Easy to deploy across multiple sites	•Reliant on staff to operate and manage •Potential Cyber security concerns
MSaaS	•Automated •Expert analysis and monitoring •Lower deployment cost •Easy to deploy across multiple sites	•Potential Cyber security concerns

Common Maintenance Strategies

Maintenance approach	Pros	Cons
Reactive	• minimal staff • lowest initial investment	• least efficient & cost-effective • increased cost of unplanned downtime, labor, repair • inefficient use of staff
Preventive	• more efficient & cost-effective: 12–18% savings over reactive • less equipment failure/ more uptime	• lack of prioritization • unnecessary maintenance
Predictive	• highly efficient & cost-effective: 8–12% savings over preventive • least equipment failure/ most uptime • improved safety, comfort, productivity, efficiency compliance • greater prioritization	• highest initial investment (staff, training, diagnostics) • savings potential not immediately seen by management
Predictive + analytics	• most efficient & cost-effective • greatest prioritization • streamlined operations • quantifiable ROI to show management	• requires robust BMS • special expertise

How Does This Fit Together?

Building

Create

Transmit

Analytics

Analyse

Aggregate

Prioritise

Your Team

Execute

Review

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Using the Actionable Information

Daily

Critical

Ongoing

Identify

Prioritise

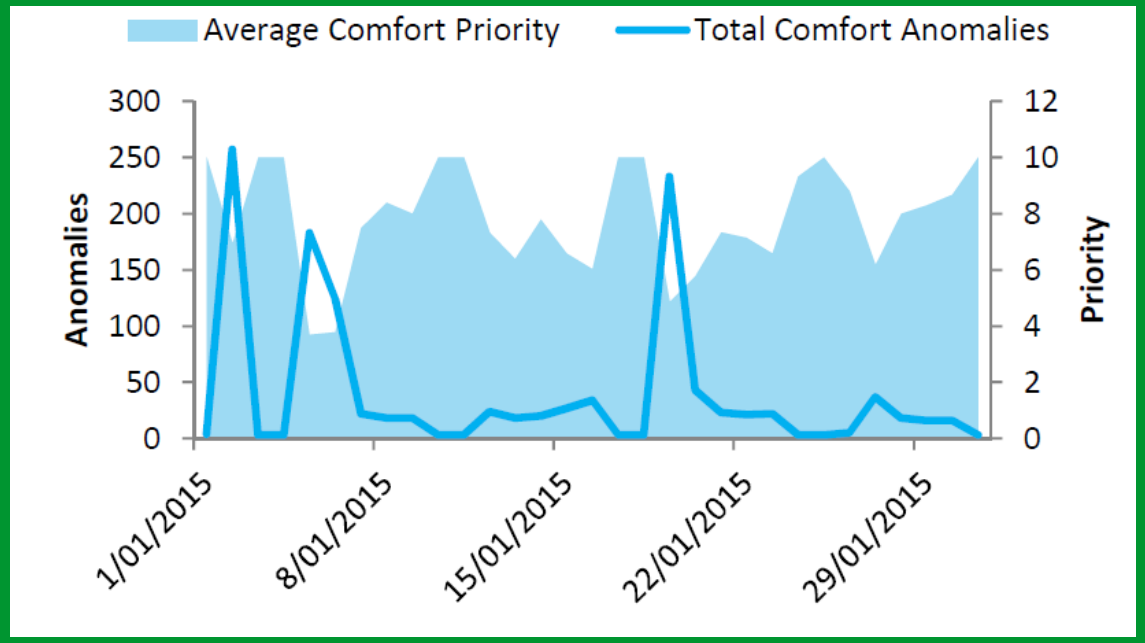
Execute

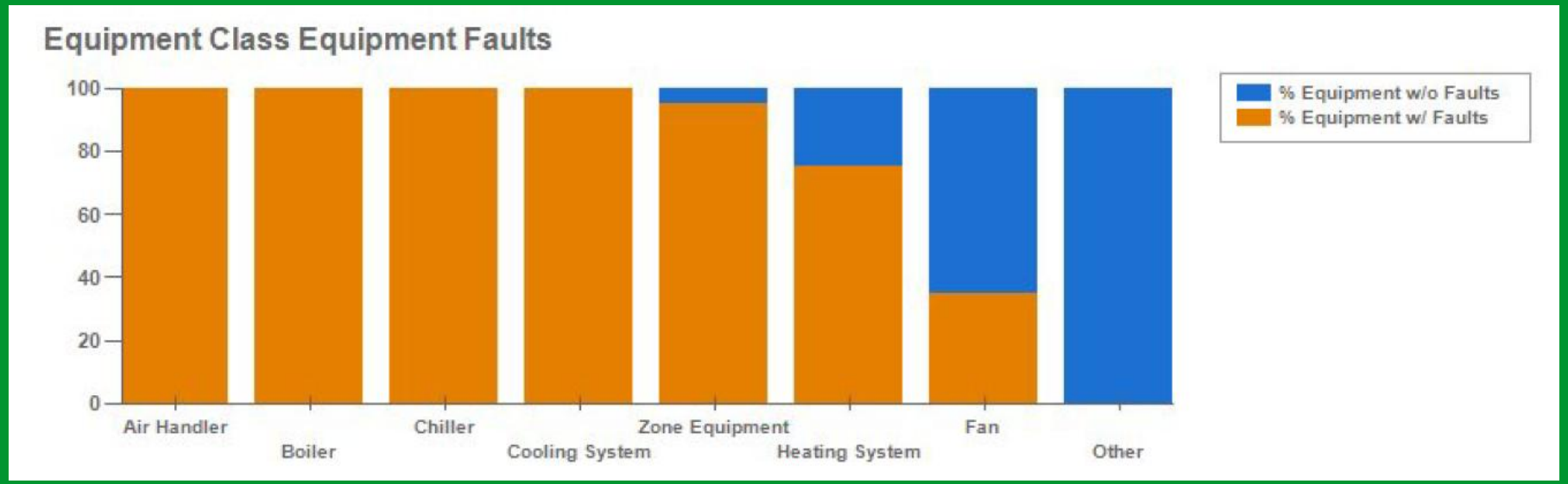
Periodic

Validate

Reporting


Boilers
100%
Heating Systems
75%
25%


Average Comfort Priority
Total Comfort Anomalies
Anomalies
Priority
300
250
200
150
100
50
0
12
10
8
6
4
2
0
1/01/2015
8/01/2015
15/01/2015
22/01/2015
29/01/2015


Equipment Class Equipment Faults
100
80
60
40
20
0
% Equipment w/o Faults
% Equipment w/ Faults
Air Handler
Boiler
Chiller
Cooling System
Zone Equipment
Heating System
Fan
Other

Fault Summary Information

Alarm	Alarm Type	Equipment	Current State	Today's Total Time in Alarm (Min.)	# Of Occurrences	Total time in Alarm Over Period (Min.)
FCU3-1 Edh Fault	Alarm	FCU 3-1	Off	0	46	294
FCU1-11 fan flt	Alarm	FCU 1-11	Off	0	10	580
AHU8-4-10edh flt	Alarm	AHU 8-4 Zone 10	Off	0	5	26
AHU8-4-4 edh flt	Alarm	AHU 8-4 Zone 4	Off	0	5	31
AHU8-4-6 edh flt	Alarm	AHU 8-4 Zone 6	Off	0	4	25
AHU8-4-9 edh Flt	Alarm	AHU 8-4 Zone 9	Off	0	3	19
AHU8-4-8 edh Flt	Alarm	AHU 8-4 Zone 8	Off	0	3	19
VAV8-1 HP Alm	Alarm	AHU 6-8 VAV 1	Off	0	1	966

Examples

> Commercial office building. Hidden faults were identified and rectified.

> Lab, office and education facility, only 5 years old. 52 VAV valves were found to be passing – enormous hidden energy costs

> Community centre, comprising rooftop package units where analytics was used to provide ongoing commissioning. ROI of 23%.

> Remote healthcare site where analytics outputs are assessed before travelling to site, resulting in reduced travel time and prompt rectification.

The world is getting smarter.

The advancement of analytics technology allows us to work smarter, not harder.

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